CLAIMS

What is claimed is:

1. A method for analyzing a sample using ion mobility spectrometry, the method comprising:
   pulsing an ion gate located at one end of a drift tube during a pre-determined scan time using a temporally spaced pattern comprising a plurality of ion admitting periods and a plurality of ion repelling periods, each ion admitting period representing a distinct length of time;
   generating a time dependent mobility spectrum associated with the sample based upon the voltage induced by a plurality of sample ions passing into the drift tube during the admitting periods and striking an ion detector disposed at a second end of the drift tube opposite the first end; and
   processing the mobility spectrum using wavelet decomposition to produce a distinct signature associated with the sample.

2. The method of claim 1, wherein the sum of all the distinct lengths of time equals about 50% of the pre-determined scan time.

3. The method of claim 1, wherein the distinct length of time associated with each admitting period corresponds to a unique admission frequency.

4. The method of claim 3, further comprising decreasing the length of time associated with each admitting period as the corresponding admission frequency increases.

5. The method of claim 1, wherein the step of processing the mobility spectrum further comprises evaluating the decomposed mobility spectrum using one or more statistical evaluators.

6. The method of claim 5, wherein five statistical evaluators are used.

7. The method of claim 6, wherein the five statistical evaluators comprise average, standard deviation, maximum, minimum, and covariance.

8. The method of claim 1, further comprising comparing the distinct signature associated with the sample to at least one known agent signature to determine if the distinct sample signature matches the known agent signature.

9. The method of claim 1, further comprising:
creating a signature for a known agent;
training a neural network using the known agent signature;
using a decision maker to compare the unique signature associated with the sample to the known agent signature to determine if the distinct sample signature matches the known agent signature.

10. The method of claim 1, further comprising:
creating a plurality of signatures for a plurality of known agents;
training a neural network using the known agent signatures;
using a decision maker to compare the unique signature associated with the sample to the known agent signatures to determine which known agent signature matches the distinct sample signatures.

11. The method of claim 10, wherein the decision maker is a fuzzy decision maker.

12. The method of claim 10, wherein the sample comprises at least a binary mixture and the step of using the decision maker to compare the unique signature further comprises identifying two or more known agent signatures matching the distinct sample signature.

13. A method for analyzing a sample using ion mobility spectrometry, the method comprising:

training a neural network using a plurality of signatures associated with a plurality of known agents;

using a fuzzy decision maker to analyze one or more sample signatures to identify one or more known agent signatures corresponding to each sample signature.

14. The method of claim 13, further comprising generating a signature for each one of a plurality of known agents by:

pulsing an ion gate located at one end of a drift tube during a pre-determined scan time using a temporally spaced pattern comprising a plurality of ion admitting periods and a plurality of ion repelling periods, each ion admitting period representing a distinct length of time;

generating a time dependent mobility spectrum associated with each known agent based upon the voltage induced by a plurality of agent ions passing into the drift tube during the admitting periods and striking an ion detector disposed at a second end of the drift tube opposite the first end; and

processing the mobility spectrum of each agent using a combination of wavelet decomposition and statistical evaluators to produce a distinct signature associated with each agent.

15. The method of claim 13, further comprising generating the one or more distinct sample signatures by:

pulsing an ion gate located at one end of a drift tube during a pre-determined scan time using a temporally spaced pattern comprising a plurality of ion admitting periods and a plurality of ion repelling periods, each ion admitting period representing a distinct length of time;

generating a time dependent mobility spectrum associated with each sample based upon the voltage induced by a plurality of sample ions passing into the drift tube during the admitting periods and striking an ion detector disposed at a second end of the drift tube opposite the first end; and

processing the mobility spectrum of each sample using a combination of wavelet decomposition and statistical evaluators to produce the distinct signature associated with each sample.

16. An ion mobility spectrometry system comprising:

a drift tube comprising an accelerating voltage potential and a counter-current drift gas;

an ion gate disposed at a first end of the drift tube;

an ion gate controller in communication with the ion gate and arranged to pulse the ion gate during a pre-determined scan time using a temporally spaced pattern comprising a plurality of ion admitting periods and a plurality of ion repelling periods, each ion admitting period representing a distinct length of time;

an ion detector disposed adjacent a second end of the drift tube opposite the first end, the detector capable of generating a time dependent mobility spectrum based upon the voltage induced by a plurality of sample ions passing into the drift tube during the admitting periods and striking the ion detector; and

a logic processor in communication with the ion detector to receive the mobility spectrum, the logic processor capable of processing the mobility spectrum using a combination of wavelet decomposition and statistical evaluators to produce a distinct signature associated with the sample.

17. The system of claim 16, wherein the logic processor further comprises a neural networked and a fuzzy decision maker, wherein the neural network has been trained using a plurality of signatures associated with a plurality of known agents.

18. The system of claim 16, wherein the ion gate controller comprises a transistor-transistor logic level clock source.